

MICROSTRUCTURED SURFACE FILM ASSEMBLY FOR LIQUID ACQUISITION AND TRANSPORT

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a divisional of U.S. Ser. No. 09/778,524, filed Feb. 7, 2001, now allowed, the disclosure of which is herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] This invention relates to microstructured films and tapes that have the capability to acquire liquids and to control the directional transport of such liquids for subsequent removal. This transport can be passive or active (i.e., enhanced by an applied potential), and the invention has utility in a number of industrial applications and assemblies.

[0003] The collection of liquid in industrial applications (e.g., spills, condensate, ink, pooled fluids, etc.) can cause subsequent problems if the liquid is allowed to remain over a period of time. Some liquid management problems lead to corrosion, power supply loss, excessive weight retention, loss in efficiency, insufficient energy usage, safety hazards, and the like.

[0004] Current methods of liquid control focus on the prevention of liquid buildup on a surface through approaches such as absorbent materials, protective films and tapes, and sealants. None of these methods, however, provide for effective liquid removal once liquid is present on a surface.

[0005] Transport of liquid across a structured surface may be characterized based upon the mechanism that causes flow of the liquid. Where liquid transport pertains to a non-spontaneous liquid flow regime wherein the liquid flow results, for the most part, from an external force applied to the structured surface, such a liquid transport mechanism is considered "active". On the other hand, where the liquid transport pertains to a spontaneous flow regime wherein the liquid movement results without the introduction of external forces, such a liquid transport mechanism is considered "passive".

[0006] Active liquid transport products have been developed based upon specific applications, including absorbent pads or a liquid pervious layer combined with liquid transport devices. For example, mat products including active liquid transport and absorbent pads or liquid pervious layers are described in U.S. Pat. No. 5,437,651 to Todd et al. and U.S. Pat. No. 5,349,965 to McCarver. In each case, channels are defined on a surface of a substrate to direct liquid flow from substantially all of the area of a liquid pervious layer. These products remove liquid while having the liquid pervious layer act as a liquid adsorbing and storing layer and/or to define a liquid receiving layer. In Todd et al., a flexible backing plate is attached to an absorbent portion and a suction source is applied to the backing plate. The backing plate comprises a plurality of channels for directing the vacuum provided by the suction source more evenly across the surface of the absorbent portion. In McCarver, a flexible pad or suction rail having a liquid permeable top surface and a liquid impermeable bottom surface is connected to a vacuum source. The suction draws liquid down into a liquid

receiving chamber as it passes through the liquid pervious layer, and draws the accumulated liquid away. The liquid receiving chamber contains separation means dividing the chamber into channels for keeping the chamber from collapsing when the chamber is placed under a negative pressure.

[0007] Another flexible liquid transport product is commercially available under the trademark "Fluid Control" floor suction mat, from Technol Medical Products Inc. This product is used to adsorb fluids that fall from a surgical site during a surgical procedure. The device has an absorbent mat that resides above a multitude of parallel and closed channels. Holes are provided in the channel surfaces that interface with the absorbent mat so that fluid recovered by the mat can be drawn into the channels. The parallel channels are connected to a manifold for attachment with suction tubing. Thus, after fluid has accumulated within the mat, removal thereof can be facilitated through the multiple channels by the application of a vacuum.

[0008] A fluid guide device having an open structure surface for attachment to a fluid transport source is described in U.S. Pat. No. 6,080,243 to Insley et al. This reference discloses an open structured surface that defines plural channels and a slot for permitting fluid communication between a distribution manifold and at least a plurality of the channels. A fluid transport source, such as a vacuum generator, is connected to the distribution manifold.

[0009] Examples of flexible fluid transport devices that utilize both active and passive fluid transport are described in U.S. Pat. No. 3,520,300 to Flower, U.S. Pat. No. 4,747,166 to Kuntz, and U.S. Pat. No. 5,628,735 to Skow. Examples of other channeled mats for fluid removal are shown in U.S. Pat. No. 4,533,352 to Van Beek et al. and U.S. Pat. No. 4,679,590 to Hergenroeder. Examples of passive fluid transport devices having channeled fluid transport structures are described in U.S. Pat. No. 5,514,120. This reference discloses the use of a liquid management member having a microstructure-bearing hydrophilic surface, preferably in combination with a liquid permeable top sheet, a back sheet, and an absorbent core disposed between the top and back sheets. The liquid management member promotes rapid directional spreading of liquids and is in contact with the absorbent core.

SUMMARY OF THE INVENTION

[0010] The present invention provides for active and passive transport for liquid acquisition and/or removal in industrial assemblies and applications using microstructured liquid control films.

[0011] The liquid control film may be incorporated to transport a liquid to a remote site, to collect a liquid on the film itself, or to disperse the liquid over an increased surface area to promote more rapid evaporation. The microstructured surface has a microstructured topology, and in preferred embodiments is a suitable hydrophilic, polymeric and flexible film. The film properties are described in terms of structure and material.

[0012] In one embodiment, the invention is a laminate liquid disposal assembly which includes a liquid control layer and a substrate layer. The liquid control layer has a top side and a bottom side, with the top side having a liquid